QTRA Tree Safety Management

Quantified Tree Risk Assessment

PRACTICE NOTE

VERSION 4

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Quantified Tree Risk Assessment Practice Note

"***When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind"***

William Thomson, Lord Kelvin, Popular Lectures and Addresses [1891-1894]

1. INTRODUCTION

The Quantified Tree Risk Assessment (QTRA) method was first published in 2005 (Ellison 2005), following which a programme of training and user registration was developed. Registered users of the QTRA method attend either a one or a two-day training workshop and receive tuition in the basic application of the method. Update workshops provide both advanced training and update information relating to revision of the method; attendance is at the discretion of the user. Users, currently, from fifteen countries have access to an internet discussion forum and receive updated information as the method evolves and develops.

A Balanced Approach

In the management of trees, risk minimisation is often cited as an objective. This alone is not a reasonable aim because the benefits of risk reduction must be balanced with its costs, both financial and in terms of lost benefits from the tree. Where risk reduction comes at a disproportionately high cost in relation to lowering the level of risk, the risk control measure can be said to be disproportionate and unreasonable. Indeed, where safety from trees is concerned, the law in the UK, both common and in statute, requires only that the occupier of land does what is reasonable (Mynors 2011). By quantifying the risk of harm from falling trees, QTRA enables comparison of the costs and benefits of risk reduction.

When managing risks in all walks of life we strive to balance the costs of our actions and choices with the benefits that they provide, and managing trees should be no different. Although the majority of tree-risk management decisions are not analysed in terms of the detailed costs and benefits of risk reduction, the balance between the costs and benefits of implementing risk control underpins the process.

Risk Assessment

Risk assessment is the overall process of risk identification, risk analysis and risk evaluation. (ISO 2009). Developed for the assessment of risks from falling trees, the QTRA method enables cost-effective identification of the risks and quantification of the risk analysis to provide a numerical aid for the evaluation and treatment of risks.

A risk from tree failure exists only if (1) there is potential for tree failure and (2) potential for harm to result. It is the task of the risk assessor to consider both the likelihood and potential consequences of tree failure. The outcome of this assessment, which in QTRA is termed the 'risk of harm', will then inform the tree manager's evaluation of the risks. Additionally, the assessor's observations can inform consideration of benefits accruing from the tree.

Through the provision of a comprehensive range of values[1], QTRA enables the tree assessor to evaluate and quantify the risk from tree failure in three key stages. (1) to value property and land-use in terms of both vulnerability to impact and likelihood of occupation, (2) to consider the relative severity of impact, taking account of the size category of the tree or branch etc. concerned, (3) to quantify within broad bands, the assessor's estimate of the probability that the tree or branch will fail within the coming year. By multiplying these values the assessor can calculate an annualised[2] risk of harm from a particular hazard. This risk is considered against broadly acceptable and tolerated levels of risk and the risks from different hazards can be ranked and compared.

Taking a Proportionate Approach

The risks from tree failure are usually very low and high risks will most commonly be encountered in areas either with high levels of human occupation or

[1] See tables 1, 2, 3 & 4.

[2] The inputs to the calculation are considered over the coming year, therefore the risk of harm relates to the same timeframe.

with valuable property. In areas of low human occupation and low property value, the assessment of risks from trees may be unnecessary beyond valuing or categorising land-use. Even when land-use indicates that the assessment of trees is appropriate, it is seldom proportionate to calculate the risk for each tree in a population. Often, all that is required is a brief but particular consideration of the trees to identify gross characteristics of structural weakness or declining health.

QTRA enables a range of approaches from the broad risk assessment of large collections of trees to the detailed assessment of each tree where land-use and the character of the trees dictate. QTRA risk calculations for groups of trees are based on the highest risk tree and if the risk from that tree is tolerable, it follows that risks from the remaining trees will also be tolerable and further calculations are unnecessary.

2. DEFINITION OF TERMS

Risk

Risk is the combination of the probability of an event and its consequence (ISO 2009).

In terms of assessing risks from falling trees and branches, the commonly quoted equation 'risk = likelihood x consequence' is appropriate; e.g. risk is the product of (1) the likelihood that the tree will fail in the coming year, (2) the likelihood of the target being occupied, and (3) the magnitude of the expected consequence.

Risk of Harm

The QTRA output is termed the 'risk of harm' and is a combined measure of the likelihood and the consequence of tree failure considered in terms of the loss, within the coming year, of a human life, something of comparable value or a proportion thereof.

ALARP (As Low As Reasonably Practicable)

Determining that risks have been reduced to 'As Low As Reasonably Practicable' involves an evaluation and comparison of both the risk to be reduced and the sacrifice or cost involved in reducing that risk. If it can be shown that there is gross disproportion between them, the risk being insignificant in relation to the sacrifice or cost, it can be demonstrated that to reduce the risk further is not reasonably practicable.

Cost and Benefit

Trees confer many benefits on people and the wider environment. Trees are essential to our well-being and enhance both built and natural environments. It is reasonable to assume that removal of all risks from trees would have disastrous consequences for the quality of life and our environment. When managing the risk from falling trees, as with any risk, it is essential to maintain a balance between the costs and benefits of risk reduction, which should be considered in the determination of ALARP (HSE 2001). It is not only the financial cost of controlling the risk that should be considered, but also the loss of tree-related benefits and the risk to workers and the public from the risk control measure itself.

Acceptable and Tolerable Risks

People are constantly exposed to and accept varying degrees of risk. For example, if you want to travel by car you must accept that even with all the extensive risk control measures, such as seat belts, speed limits, air bags, and crash barriers, there is still a significant risk of death. This is an everyday risk that is taken for granted and accepted by millions of people in return for the benefits of convenient travel.

The 'Tolerability of Risk Framework' (ToR) (HSE 2001), which is represented graphically in Figure 1 considers a range of risk, with at one end the risk being 'broadly acceptable' – where there is no need to consider further risk reduction – and at the other end the risk is 'unacceptable' and not to be tolerated. However, when a risk is of such a magnitude that it is no longer broadly acceptable, it may still be tolerated if it is ALARP. In other words, the risk may be tolerable if the cost of further reducing it is grossly disproportionate to the benefit of risk reduction. Both 'tolerability' and 'gross disproportion' are concerned with whether or not the benefits of risk control are sufficient to justify the cost of the control.

In terms of its general application, the Tolerability of Risk Framework can be summarised as having (1) a 'broadly acceptable region' where the upper limit is an annualised risk of death 1/1 000 000, (2) an 'unacceptable region' of which the lower limit is 1/1 000, and between these (3) a necessarily wide 'tolerable region' within which the tolerability of a

risk will be dependent upon the costs and benefits of further risk reduction.

In respect of trees, many risks cross the broadly acceptable 1/1 000 000 boundary, but remain tolerable because any further reduction would involve a disproportionate cost in terms of the lost environmental, visual and other benefits in addition to the financial cost of controlling the risk.

The UK Health and Safety Executive (HSE 2001) suggests that "***an individual risk of death of one in a thousand per annum should on its own represent the dividing line between what could be just tolerable for any substantial category of workers for any large part of a working life, and what is unacceptable for any but fairly exceptional groups. For members of the public who have a risk imposed on them 'in the wider interest of society' this limit is judged to be an order of magnitude lower – at 1 in 10 000 per annum.***" Furthermore, ***"HSE believes that an individual risk of death of one in a million per annum for both workers and the public corresponds to a very low level of risk and should be used as a guideline for the boundary between the broadly acceptable and tolerable regions."***(ibid).

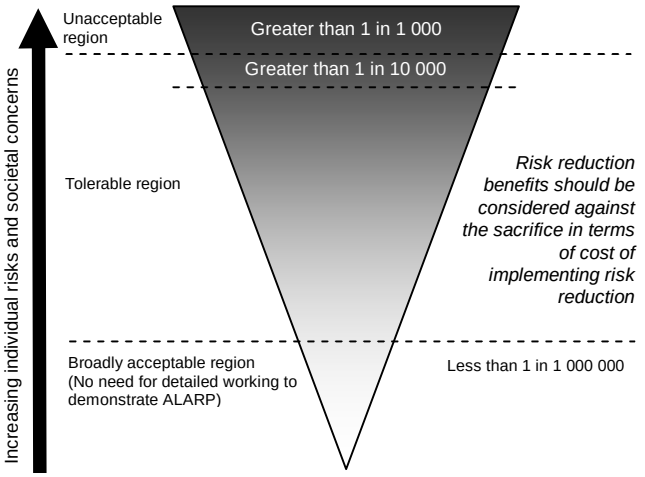
Unacceptable region
Greater than 1 in 1 000
Greater than 1 in 10 000
Tolerable region
Risk reduction benefits should be considered against the sacrifice in terms of cost of implementing risk reduction
Broadly acceptable region (No need for detailed working to demonstrate ALARP)
Less than 1 in 1 000 000
Increasing individual risks and societal concerns

Figure 1. Adapted from the Tolerability of Risk framework (HSE 2001)

Value of Statistical Life

In QTRA, placing a statistical value on a human life has two particular benefits. Firstly, the 'value of statistical life' (VOSL), as a widely applied risk management device, uses the notional value of a hypothetical individual life to guide the proportionate allocation of resources to risk reduction. In the UK, this value is currently in the region of £1 000 000 - £1 500 000. ***"A value of statistical life of £1 000 000 is just another way of saying that a reduction in risk of death of 1/100 000 per year has a value of £10 per year"*** (HSE 1996). Secondly, the QTRA method utilises VOSL to equate the value of damage to property with the value of life e.g. where a life has a statistical value of £1 000 000, a building with a replacement cost of £10 000 is valued at 0.01 (1/100) of a life, which allows comparison of the risks to people and property.

Internationally, there is wide variation in VOSL and its computation. In QTRA, the value of £1 000 000 is currently applied both to provide a consistent basis for comparing the loss of life with the loss of property and to equate the costs and benefits of risk reduction. To provide consistency in QTRA outputs, VOSL of £1 000 000 should be applied internationally.

Target

In the context of tree-failure risk assessment, a target is anything of value that could be harmed in the event of tree failure.

3. OWNERSHIP OF RISK

Where many people are exposed to a risk, it is shared between them. Where only one person is exposed, that individual is the recipient of all of the risk and if they have control over it they are also the owner of the risk. As individuals, we are concerned mostly with the risks to ourselves and those close to us, but as shared risks that are imposed upon the wider community become elevated, societal concern – through regulatory control or common law duties - will usually require the implementation of risk controls.

Although QTRA outputs might occasionally relate to the individual, this is seldom the case. More often in QTRA, calculation of the risk of harm is based on the total time that the target area is occupied – i.e. how many people per hour or how many vehicles per day – without attempting to identify how many different individuals share the risk.

Where the risk of harm relates to a specific individual or a known group of people, the risk manager might consider the views of those who are exposed when formulating management decisions. On the one hand, the benefits associated with the risk may be enjoyed by the wider community, but not by those exposed to the risk and on the other, an

exposed person might explicitly accept an elevated risk in return for particular benefits.

4. THE QTRA METHOD

When applying the QTRA method, the assessor quantifies, as probabilities, the three components of the tree failure risk: 1) Target, 2) Impact Potential (size), and 3) Probability of Failure within the coming year. The quantifications are applied in broad ranges of value[3] and calculated using the upper value for each range, which are multiplied and their product is the annualised 'risk of harm'. To simplify the assessment process, the ranges, or bands, are applied on the basis of their upper values, but where the risk of harm approaches an actionable threshold the assessment can be considered in more detail before proposing control measures.

Target Evaluation

Frequent assessment of trees and of associated risks may be essential in areas of high public access where trees are within striking range of people or valuable property that is susceptible to damage. Conversely, in locations without valuable property and having very low human access, the survey and assessment of trees for safety is unlikely to be necessary. Therefore, the nature of the target beneath or adjacent to a tree will usually dictate the level of risk assessment that is required.

In the initial assessment of targets, six ranges of value are used. Table 1 sets out these values for vehicular frequency, human occupation and the monetary value of damage to property.

Human Occupation

The probability of pedestrian occupation at a particular location is calculated on the basis that a pedestrian will spend, on average, five seconds walking beneath the average tree. For example, ten pedestrians per day each occupying the target for five seconds is a daily occupation of fifty seconds, by which the total seconds in a day are divided to give a probability of target occupation (50/86 400 = 1/1 728). Where a longer occupation is likely, as with a habitable structure, outdoor café or park bench, the period of occupation can be measured or estimated as a proportion of a given unit of time, e.g. six hours per day (1/4).

[3] See tables 1, 3 & 4.

The target will ordinarily be recorded in the QTRA as a range (1 - 6, Table 1). When the assessor identifies an elevated risk, the target can be more accurately calculated and recorded.

Often the nature of a structural weakness in a tree is such that the probability of failure is greatest during windy weather, whilst the probability of the site being occupied by people during such weather conditions is often considerably reduced; this particularly applies in woodlands, parks and private gardens. To account for the influence of weather on the risk from tree failure, the occupation by people is considered specifically in relation to weather conditions. When estimating human targets, the risk assessor must answer the question 'in the weather conditions that I expect the likelihood of failure of the tree to significantly increase, what will be the likely level of human occupation?' Taking this approach, rather than valuing the average usage, ensures that the assessor considers the multi-faceted relationship between weather, people and trees, and the sentient nature of the average person with their ability to recognise and avoid unnecessary risks.

A target can be constantly occupied by more than one person and it is necessary to consider the probability of multiple occupancy. For example, if it is projected that the average over a one-year period will be constant occupation by 10 people, the risk of harm in relation to one person constantly occupying the target is calculated before going on to identify that the average occupation is 10 people. This is expressed as target 1(10T)/1, where 10T represents the number of people or vehicles constantly occupying the target. In respect of monetary value of property, this would be equivalent to a risk of losing £10 000 000 as opposed to £1 000 000.

Vehicles on the Highway

In the case of vehicles, probability of occupation may relate to either the falling tree or branch striking the vehicle or the vehicle striking the fallen tree. Both types of impact are influenced by vehicle speed; the faster the vehicle travels the less likely it is to be struck by the falling tree, but the more likely it is to strike a fallen tree. 'Stopping distances' and an average vehicle length are used in the calculation of vehicle occupation of highways. The probability of a vehicle occupying any particular point in the road is the ratio of the time a point in the road is occupied by vehicles - including a safe stopping distance - to the total time in a day. The average vehicle on a UK

road is occupied by 1.6 people (DfT 2010). To account for the substantial protection that the average vehicle provides against most tree-failure impacts and in particular, frontal collisions, QTRA values the substantially protected 1.6 average occupants summed with the average vehicle value as equivalent to one exposed human life.

Property

When assessing risks in relation to buildings, the target might be the building or the occupants and the building. It is necessary for the assessor to consider whether occupants of a building are either protected from harm by the structure or substantially exposed to the impact from a falling tree.

When evaluating the exposure of property to tree failure, it is necessary to estimate approximately the cost of repair or replacement that might result from failure of the tree as represented in Table 1.

As previously described, the ranges of monetary value for property used in Table 1 are based on the assumption that, for the purpose of the risk assessment, the loss of £1 000 000 is equivalent to the loss of a life. For example, target range 2 represents a probability of human occupation up to 1/20 (£1 000 000 ÷ 20 = £50 000). Therefore, a likely property repair cost of £50 000, which is one-twentieth the value of VOSL, is apportioned 1/20 in the QTRA.

On 1st January each year, Quantified Tree Risk Assessment Ltd. provides users of the method with monetary conversion rates that enable application of the method internationally.

Table 1. 'Target' ranges for property, pedestrians and vehicles.

Target Range	Property (repair or replacement costs)	Pedestrian Frequency	Vehicular Frequency examples	Probability (of occupation or fraction of value of £1 000 000)
1	>£50 000 - £1 000 000	>36 per hour - constant	26 102 vehicles @ 110kph (68mph) 32 359 vehicles @ 80kph (50mph) 46 702 vehicles @ 50kph (32mph)	1/1
2	>£14 000 - £50 000	>10 per hour - 36 per hour	1 305 vehicles @ 110kph (68mph) 1 617 vehicles @ 80kph (50mph) 2 335 vehicles @ 50kph (32mph)	1/20
3	>£1 400 - £14 000	>1 per hour - 10 per hour	363 vehicles @ 110kph (68mph) 449 vehicles @ 80kph (50mph) 649 vehicles @ 50kph (32mph)	1/72
4	>£60 - £1 400	>1 per day - 1 per hour	36 vehicles @ 110kph (68mph) 45 vehicles @ 80kph (50mph) 65 vehicles @ 50kph (32mph)	1/720
5	>£10 - £60	> 1 per week - 1 per day	2 vehicles @ 110kph (68mph) 2 vehicles @ 80kph (50mph) 3 vehicles @ 50kph (32mph)	1/17 280
6	≤ £10	≤ 1 per week	None	1/120 960

Vehicular, pedestrian and property targets are categorised by their frequency of use or their monetary value. For example, the probability of a vehicle or pedestrian occupying a target area in 'target' range 4 is between the lower and upper limits of >1/17 280 and 1/720. E.g. using the 'value of statistical life' of £1 000 000 the property repair or replacement value for 'target' range 4 is >£60 - £1 400.

Vehicular frequency examples for 'target' range 1 are calculated on the basis of the stopping distance for a given road speed providing a duration of occupation for the average vehicle on that road. The total time in a day is divided by the duration of occupation with the quotient being the number of vehicles per day required to produce constant occupation. All other 'target' ranges are calculated as a proportion of the 'target' range 1 value.

Impact Potential

A small dead branch of less than 10mm diameter is unlikely to cause significant harm even in the case of direct contact with a target, whilst on average a falling branch with a diameter greater than 450mm is likely to cause some harm in the event of contact with all but the most robust target. The increased potential for harm in relation to the size of tree or branch is proportional to a degree but this is by no means a linear relationship and there is a limit to the severity of harm in relation to the force upon impact by a tree.

The QTRA method categorises 'Impact Potential' by the diameter of tree stems and branches. A biomass equation derived from weight measurements of trees of different stem diameters is used to produce a data set (Table 2) of comparative weights of trees and branches ranging from 10 to 600mm diameter.

A diameter of 600mm has been selected to represent upper limit of size in the QTRA calculation. This threshold provides a baseline for the comparative valuation of potential impact from trees. The increased potential for harm from trees larger than 600mm diameter is not considered in terms of increased force upon impact, but might be considered in relation to the increased target area that could be affected by a larger tree.

The 'impact potential' values are grouped into five ranges of size (Table 3).

Occasionally, an assessor will take the view that the reduction in mass arising from dieback and degradation of a tree or branch is significant in the risk assessment and will discount the Impact Potential component by applying a 'reduced mass' value. If the mass of a branch is considered to be half that of a live branch of the same diameter, a reduced mass of 1/2 might be applied, reducing the 'impact potential' and thereby the overall risk of harm by half. This consideration might be on the basis that the branch is lighter as a result of degradation (lesser force on impact) or is reduced in size (smaller area of impact), and while the latter could be considered by adjusting the target value, this would usually require a disproportionate amount of time in revaluing the target.

Table 2. Biomass weight estimates.

Dbh (mm)	Weight (kg) $y=ax^b$	Fraction of weight as a ratio
10	0. 11263	1/23 505.722
25	1. 0713	1/2 471.6699
50	5. 8876	1/449.74
100	32. 357	1/81.834
150	87. 67	1/30.203
200	177. 82	1/14.891
250	307. 77	1/8.604
300	481. 81	1/5.496
350	703. 8	1/3.762
400	977. 26	1/2.71
450	1 305. 5	1/2.03
500	1 691. 4	1/1.566
550	2 138	1/1.24
600	2 647	1/1

Source. Tritton & Hornbeck (1982)x=dbh (cm); y=dry weight estimate; a=allometric coefficient 0.1126294414; b= allometric coefficient 2.458309949

Table 3. Impact Potential.

Impact potential range	Size of part likely to impact the target	Impact Potential
1	> 450mm (18") dia.	1/1
2	> 250mm (10") dia.- 450mm (18") dia.	1/2
3	>100mm (4") dia.- 250mm (10") dia.	1/8.6
4	> 25mm (1") dia.- 100mm (4") dia.	1/82
5	10mm ($^2/_5$") dia.- 25mm (1") dia.	1/2 500

* Range 1 is based on a diameter of 600mm.

Probability of Failure

The Probability of Failure component has seven ranges, each representing a range of probability of tree or branch failure occurring within the coming year, and calculated from the upper value of that range. Probability of failure is recorded in the QTRA assessment as the upper limit of a range (1 – 7, Table 4).

Table 4. Probability of Failure.

Probability of failure range	Probability
1	1/1 - 1/9
2	1/10 - 1/90
3	1/100 - 1/900
4	1/1 000 - 1/9 000
5	1/10 000 – 1/90 000
6	1/100 000 – 1/900 000
7	≤1/1 000 000

The probability that the tree or selected tree-part will fail within a year.

The QTRA Calculation

The product of the three component values is the annualised 'risk of harm', which is expressed as a probability and rounded, to one significant figure.

Below are two examples of QTRA calculations.

Example 1.

	Target		Impact Potential		Probability of Failure		Risk of Harm
Range	6		1		3		
Probability	1/120 960	x	1/1	x	1/100	=	1/10 000 000

Example 1 is the assessment of a large, very unstable tree with a probability of failure of between 1/100 and 1/900 for the coming year situated in a low use recreational area. The target is a footpath with less than one pedestrian passing the tree each day and falls within target range six.

Example 2.

	Target		Impact Potential		Probability of Failure		Risk of Harm
Range	1		2		5		
Probability	1(5T)/1	x	1/1	x	1/10 000	=	1(5T)/10 000

In example 2, a large defective branch overhangs a busy urban high street that is on average occupied constantly by five people and here multiple target occupation is considered.

The risk of harm 1(5T)/10 000, having an occupancy of five people, has a fivefold increase in the magnitude of consequence and is therefore equivalent to a risk of harm 1/2 000 and would ordinarily require risk control.

Accuracy of Outputs

The purpose of QTRA is not necessarily to provide high degrees of accuracy, but to provide for the quantification of risks from falling trees in a way that a risk can be assessed within broad ranges where this is sufficient and with greater rigour when required.

Where the input values are broadly estimated, the proposed risk thresholds should be applied cautiously. Where the manager is reasonably confident in the input values, the thresholds can be more rigorously applied. An example of this would be where, based on an initial brief assessment, a recreational woodland target is estimated to be within range 5 (up to one person passing each day). As a result, no tree in the woodland can achieve a risk of harm exceeding 1/20 000. This is because even with a large unstable tree the 'general limit of tolerability' of 1/10 000 is not exceeded (target 1/17 280 x impact potential 1/1 x probability of failure 1/1 = 1/20 000). If the occupancy is based on accurate historical data, a detailed assessment of the trees is unlikely to be necessary for safety purposes. However, in order to make a decision not to assess the trees, it would be necessary to be reasonably confident that the target valuation is either based on accurate data or an over estimate. If the landowner had estimated an occupation of one person every two or three days, one could be reasonably confident that there was no need to assess the trees because range 5 values the target at one person a day. Conversely, where the occupancy might be as high as two or three people a day, then it could be appropriate to monitor and measure occupation more accurately.

5. MAKING RISK MANAGEMENT DECISIONS

Applying the ToR Framework to QTRA Outputs

It is proposed that, in applying ToR to the outputs of QTRA, an annualised risk of harm 1/1 000 000 is the 'broadly acceptable limit', below which the risk is already ALARP. A risk of significant harm, 1/10 000 is the 'general limit of tolerability' and 1/1 000 is the 'extraordinary limit of tolerability'.

Between the 'broadly acceptable limit' (1/1 000 000) and the 'extraordinary limit of tolerability' (1/1 000) is the 'tolerable region of ToR. Where a risk falls within this region, it is necessary to consider whether it is ALARP. Here, management decisions are informed by consideration of the costs of risk control, including the nature and extent of benefits that would be lost to risk control measures. The assessor might consider the costs of risk control when providing options for management, but the tree manager, who owns the risk and exercises control over the costs, will consider the balance and make the final decision.

Considering Benefits from Trees

When implementing risk reduction there will usually be a financial cost. In this regard and even without considering the non-monetary costs, VOSL can be used to evaluate the proportionality of a risk control.

Using a VOSL of £1 000 000, it can be established that a reduction in the risk of death from 1/10 000 to 1/1 000 000 – from the 'general limit of tolerability' to 'broadly acceptable' - has a value of £100 per year. Example 3 puts this evaluation into a tree management context where the benefit in terms of risk reduction can be considered against the financial cost.

Example 3.

	Target		Impact Potential		Probability of Failure		Risk of Harm
Range	3		3		3		
Probability	1/72	x	1/8.6	x	1/100	=	1/60 000

In example 3, a large defective branch (impact potential range 3) overhangs a country road along which travel on average five hundred vehicles each day at an average speed of 30 mph (target range 3). The branch has a compromised attachment to the tree and is assessed as having a probability of failure for the coming year of between 1/100 and 1/900. The risk of harm is calculated as 1/60 000 and it needs to be considered whether the risk is ALARP. The cost of removing the branch and reducing the risk to broadly acceptable (1/1 000 000) is roughly estimated at £250. To establish whether this is a reasonable cost of risk control, the following equation is applied. £1 000 000 x 1/60 000 = £16.66 indicating that the projected cost of £250 would, even if allocated over ten years, probably be grossly disproportionate to the risk when considered in addition to the tree-related benefits that will be lost and the risks to tree workers from implementing the risk control measure.

There will be occasions when a tree is of such minimal value and the monetary cost of risk reduction so low that it might be reasonable to further reduce an already relatively low risk. Conversely, a tree might be of such considerable value that an annual risk of death greater than the 'general limit of acceptability' of 1/10 000 would be deemed tolerable. These thresholds and costs, against which risk reduction is balanced, can be informed by the risk assessor but must be selected by or agreed with the owner or manager of the risk.

Summary of QTRA Risk Thresholds

1. Broadly Acceptable: 1/1 000 000 – below which the risk is already ALARP.
2. Tolerable Region: between 1/1 000 000 and 1/1 000 – risks will be considered in order to determine whether they are ALARP and the costs of both expenditure and lost benefits will be balanced against the benefits of risk reduction.
3. General Limit of Tolerability: 1/10 000 – the limit of tolerability for the imposition of a risk upon others. This limit will usually be tolerable if the risk manager considers that tree confers not necessarily a special benefit, but a reasonable level of benefit that might ordinarily be expected from a tree of its type and age.
4. Extraordinary Limit of Tolerability: 1/1 000 – The upper limit of risk tolerance, which might be applied in exceptional circumstances where particularly special benefits would be lost to risk control measures. Management decisions to retain trees that are assessed as being between 1/10 000 and 1/1 000 would ordinarily require broad stakeholder support.

A tree owner may choose to operate to a higher or lower 'general limit of tolerability' than the proposed 1/10 000, but whatever level is chosen, the precision with which limits are applied should reflect the manager's confidence in the risk assessment outputs.

International Versions

As with previous versions, monetary values in this practice note will be adapted for use in all countries where there are QTRA users. Currency specific versions will be available at www.qtra.co.uk from 1 September 2012.

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